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Parametric simulation as a tool for observing relationships between parcel and regulations in unplanned commercial corridor

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Abstract

The development processes of residential areas by several developers are not integrated. They tend to create spaces that are not well connected. The connection between two or more development areas (which is used as main access) grows into a commercial corridor that shows irregularities. To control the development in such commercial corridor, the government has set certain regulation. This study aims to examine the relationship between the characters of parcel and those certain regulations. The characters of parcel consist of (among others) dimensions and geometric shapes. The aforementioned relationship will result in certain mass and form. This analysis is done through simulation using certain regulations as parameter. Those regulations are Building Coverage Ratio (BCR), Floor Area Ratio (FAR) and Building Setback. The simulation process is applied to the existing parcel and the object of study is a commercial corridor between Serpong and Tangerang areas.

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Keywords: Regulation; Commercial Corridor; Parametric Simulation

1. Introduction

Private developers' big role in choosing, planning, and developing a new area significantly affects the development of its surroundings. The development of Jakarta Greater Area (Jabodetabek) shows that new towns are

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established without a coherent development planning which does not follow the local government's development master plan (Sujarto 2000, 86). Developers can set up their own master plans and present them to the government for permission. The process is unlike new town development planning in other countries, where the government restricts developers' ability to plan and develop infrastructures (Dieleman 2011, 81).

1.1. The phenomenon of Discontinuity Between Areas

A significant effect of disintegrated development is discontinuity between areas developed by different developers. These areas are not well-connected to the existing infrastructure system (Dijkgraaf 2000). The development of new areas that are not integrated to road infrastructure possibly results in disconnected areas. A few phenomena can show disintegrated planning in some areas within a certain region. The development of a new residential area in an existing infrastructure, such as arterial roads belonging to the provincial government, will expand the commercial capacity of the road into a commercial strip. Such expansion does not only create function and activity dynamics, but also density, space, and shape dynamics. The visible signs of this expansion are irregularities and various architectural elements forming the corridor. The development of a road into a commercial corridor, as well as its roles as a main access for a new town indicate the characteristics of a heterogeneous and irregular commercial corridor.

The connecting corridor between Serpong and Tangerang is one case of commercial corridor development in arterial roads (which are the main access for new residential areas). An overwhelmingly rapid development in those areas changed the road that initially connects Tangerang with its surrounding areas (such as Serpong) into a city commercial corridor. The development of Bumi Serpong Damai satellite city initiated the growth and expansion in Serpong area in 1980s. This expansion of commercial capacity consequently filled the empty spaces along the corridor, as well as with the existing production capacity such as factories and warehouses.

1.2. Regulation as a Control for Building Mass Form

Zoning basically functions only to prevent property owners from developing unsuitable development (that burdens the public) in their environment. Zoning regulation does not have the ability to create aesthetic, orderliness, or comfort despite its legal power (Spreiregen 1965). In order to create a sustainable and good city environment, zoning regulation is supposedly complemented with design and planning tools, including a building code that serves as standard.

A more detailed regulation plays an important role in maximizing access through regulating block, density and proximity between functions. Such regulation will enable variation of use. Talen maintains that regulating measurement (or dimension), distance and width gives room for a better city pattern. This relationship is not only related to parcel size, but also road size where the parcel is located. Furthermore, this matter has to be governed by certain sets of building and construction standards such as building width, height and use (Talen 2012, 72).

Form gives attention to the shape of space in three dimensional perspective (Talen 2012, 17). Form is governed by rules regarding building line, setbacks, lot coverage, function of street width, building type, and building height. Krier argues that building typology and morphology and how they are related to city road will affect city space (Krier 1979). Thus, the forms of buildings and how they are related to city road will definitely have an effect on a city's three-dimensional form formation.

Local government has made effort in regulating and controlling the corridor development. They do so by following the Building and Environment Development Plan which is derived from the earlier regulations and policies. This research sought to examine the application of such regulations on the existing parcel and the possible forms that might take place as its result.

2. Method

Data is collected through field observation, interviews, documents examination and mapping. Data regarding regulations is mainly collected directly from local authorities. Some of those regulations are still awaiting approval. Interviews provide the information needed in explaining the details of some existing regulations and their relationship

to other regulations that direct them. The interviews are conducted with the Head of South Tangerang City Government and Tangerang National Land Agency (*Badan Pertanahan Nasional*, a part of the Indonesian Agrarian Ministry). The National Land Agency provides the map that is required to get the registered dimension predictions and parcel shapes. This map has a high level of accuracy of parcel shapes as it is drawn on the scale of 1:1000. It also shows the ownership status of each parcel..

2.1. Parametric Approach

Parametric approach is an interesting method to use in examining an existing urban condition with existing field (da Silva and do Eirado Amorim 2010). In the case of commercial corridor that connects two new towns, a corridor is a physically existing condition and it develops quickly. Unlike the structured new city development, the development in commercial corridor is not structured and does not begin from an empty area.

In an urban design, supporting components can also be defined parametrically because there are a lot of similarities among them. These supporting components include: density, mass, utilization, shape, space and typology. Regulation aspects that apply to a city include: utilization, percentage and maximum and minimum number criteria. These components will in turn control the design supporting components. Thus, parametric approach (whose purpose is to reach efficiency through different simulations) is suitable to examine the application of regulations and to predict its outcome.

2.2. Utilization of Computer Simulation

Computation technology in design enables the utilization of mathematical concepts such as algorithm. Algorithm is a systematic procedure or steps to procure a solution to a problem. Algorithm is known to have starting input, process and output in computer programing. It helps giving answer to problems that have many different inputs but essentially only need one procedure to reach a solution. Parametric approach makes use of algorithm because it is capable to create shapes that are initially undetermined (Terzidis 2006). Every end shape resulted is a product of the parameters inputted during the initial process. Nonetheless, there are certain restrictions that need to be set in algorithm in order to get the desired output. Unrestricted parameters might end up giving undesirable output.

This study uses computation technology to facilitate the simulation process. The computer application used to simulate based on parameters is Grasshopper from Galapagos. Algorithm is commonly used by programmers. Nevertheless, Galapagos tries to provide a generic platform for algorithm application that is usable for non-programmers (Rutten 2014). Grasshopper facilitates the shape simulation process based on the designated regulations as parameters of the study object.

3. Result and Discussions

Interpretative analysis is done to explain and examine the sustainability of regulations between properly planned (structured) and improperly planned (not structured) areas. Analysis data of the existing regulations in the case of study is then collected and connected in a matrix to aid the simulation process with the aforementioned computer application. The simulation is executed based on the parameter data from the National Land Agency maps and regulation matrix. The data is processed with parametric approach to create a mass simulation. The result of the simulation eventually shows the tendency of shapes as a result of the relationship between shape, parcel and regulations.

As a part of South Tangerang city administration, Serpong corridor is planned based on Tangerang Selatan Regional Layout Plan. The development regulation here constitutes of layout (in regional level), zoning and operationalization (in parcel and building level) regulations. Zoning regulation data for structured area is a part of the New City Master Plan, while zoning regulation for corridor is a part of zoning plan regulated by government regulation regarding Bogor Puncak Cianjur as water reservation area.

The sustainability of the zoning regulation that is included in the New City and Structured Area Master Plan follows that of the zoning regulation set by the government. Seen on the zoning map are two planned areas: Alam

Sutera and Bumi Serpong Damai. These two areas have nodes that are connected to corridor as entry accesses. That shows the sustainable planning of the area as a commercial area. Residential areas are located in the second layer. Some are even clustered separately. According to the zoning regulation data, there is a difference between commercial block and commercial strip. The former covers an area with spacious parcel sizes to form up a block in the periphery of a planned area. The latter is the first layer of parcels that directly faces the street in the corridor.

Building Coverage Ratio (BCR), Floor Area Ratio (FAR), Building Setback code form up the regulation that manage the building mass development in corridor. The regulation depends on the function and size of the parcel. The Building and Environment Development Plan of South Tangerang city government contains the aforementioned regulation data. BCR is the total square feet of the parcel the building is located on divided by the total square feet of the whole parcel. The amount of the BCR is determined by the possible constructed minimum and maximum percentages according to existing regulations. FAR is the total square feet of a building divided by the total square feet of the parcel the building is located on. FAR will thus determine the possible height of a building in a certain parcel.

Location, function, total square meters and ownership are some factors that differentiate various types of parcels. Based on its location, a parcel can be part of new development area or in an existing corridor. Based on its total square meters, a parcel can be categorized into: smaller than 1.500m^2, 1.501-3.000m^2, 3.003-5.000m^2, 5.001-10.000m^2 and bigger than 10.000m^2. Based on its function, a parcel is categorized into: industrial, residential, commercial, military, public service, government and multifunction parcels. Based on its ownership, a parcel is categorized into: certified and uncertified parcels. The object of this study is the Serpong-Tangerang corridor. The chosen segment is between Alam Sutera and Ashobirin Hospital.

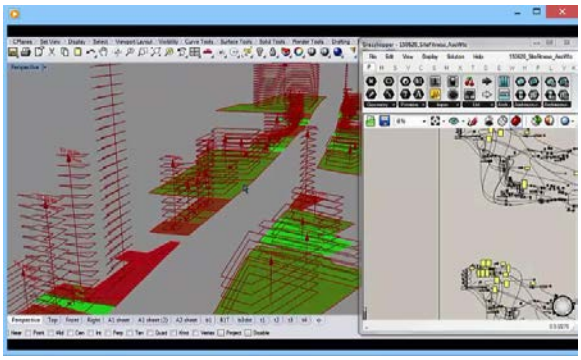

Fig. 1. Parametric Simulation Processing as a modeling tool

The effectiveness referred to in this study is the difference between available area able to build according to BCR and after applying building setback code. There is some loss of parcel built area if the building setback code applied on certain parcel type. The loss of parcel's effectiveness is shown on the effectiveness result table. The government sets maximum percentage of BCR to limit the maximum size of ground floor. The parcel can be effective if the percentage of loss effectiveness in the range of Building Coverage Ratio. Building setback, however, determines the distance or space between a parcel and its surrounding elements. This distance or space is used to ensure that a building has enough sunshine and good air circulation. The FAR affects the mass and shape of a building. The maximum ground floor area is strictly determined by the application of BCR and building setback. A calculation of a certain parcel (size and dimension) according to BCR might not be possible when building setback is taken into account. From the simulation done for the parcels along the corridor, a decrease in the effective constructible parcel sizes is noticeable when building setback regulation is applied.

Fig. 2. Lot Subdivision layout of Alam Sutera – Ashobirin Hospital Segment

The simulation graphic as seen above, show some colours that indicate the rate of effectiveness. The dark green color shows the most effective lot according to its form and dimensions. The red colour shows the lowest effectiveness that can be achieved of certain lots.

Table 1. Most effective parcels of Alam Sutera-Ashobirin Hospital Segment

Parcel	Size (m2)	Range of Size (m2)	Min BCR (%)	Max BCR (%)	FAR	Front SB (m)	Side SB (m)	Rear SB (m)	% Loss of Parcel Effectiveness
B25	6676	<1500	0.3	0.6	1.8	24	0	3	0
B31	712	<1500	0.3	0.6	1.8	24	0	3	0
B35	1252	<1500	0.3	0.6	1.8	24	0	3	0
T7	953	<1500	0.3	0.6	1.8	24	0	3	0
T13	237	<1500	0.3	0.6	1.8	24	0	3	0
B0	48869	>10000	0.2	0.7		30	9	9	0
T2	24213	>10000	0.2	0.7		32	6	9	0
B32	14664	1501-3000	0.3	0.6		25	4	4	0
B40	17379	3001-5000	0.3	0.6		25	4	4	0
B3	943	<1500	0.3	0.6	1.8	24	0	3	8.19
B34	1268	<1500	0.3	0.6	1.8	24	0	3	11.84
B39	6475	5001-10000	0.25	0.6		32	6	9	12.61
B22	4968	3001-5000	0.3	0.6		25	4	4	18.86

Table 2. The ineffective parcels of Alam Sutera-Ashobirin Hospital Segment

Parcel	Size (m2)	Range of Size (m2)	Min BCR (%)	Max BCR (%)	FAR	Front SB (m)	Side SB (m)	Rear SB (m)	% Loss of Parcel Effectiveness
B6	649	<1500	0.3	0.6	1.8	24	0	3	60.74
B11	585	<1500	0.3	0.6	1.8	24	0	3	60.96
T19	2028	1501-3000	0.3	0.6	2	25	4	4	64.34
B30	966	<1500	0.3	0.6	1.8	24	0	3	66.30
B14	2019	1501-3000	0.3	0.6	2	25	4	4	73.48
B33	802	<1500	0.3	0.6	1.8	24	0	3	77.33
T23	355	<1500	0.3	0.6	1.8	24	0	3	77.60
T11	2012	1501-3000	0.3	0.6	2	32	6	9	82.16
T14	259	<1500	0.3	0.6	1.8	24	0	3	84.23
T6	503	<1500	0.3	0.6	1.8	24	0	3	85.64
B10	1239	<1500	0.3	0.6	1.8	24	0	3	88.68
T20	661	<1500	0.3	0.6	1.8	24	0	3	90.26
B9	386	<1500	0.3	0.6	1.8	24	0	3	91.92
B8	236	<1500	0.3	0.6	1.8	24	0	3	97.07
B16	173	<1500	0.3	0.6	1.8	24	0	3	>100
B17	163	<1500	0.3	0.6	1.8	24	0	3	>100
B19	266	<1500	0.3	0.6	1.8	24	0	3	>100
B23	1256	<1500	0.3	0.6	1.8	24	0	3	>100
B26	165	<1500	0.3	0.6	1.8	24	0	3	>100
B27	163	<1500	0.3	0.6	1.8	24	0	3	>100
T9	1065	<1500	0.3	0.6	1.8	24	0	3	>100
T15	188	<1500	0.3	0.6	1.8	24	0	3	>100
T21	556	<1500	0.3	0.6	1.8	24	0	3	>100
T22	252	<1500	0.3	0.6	1.8	24	0	3	>100
T24	375	<1500	0.3	0.6	1.8	24	0	3	>100
T25	327	<1500	0.3	0.6	1.8	24	0	3	>100
T26	566	<1500	0.3	0.6	1.8	32	6	9	>100
T3	10478	>10000	0.2	0.7	8	25	4	4	>100

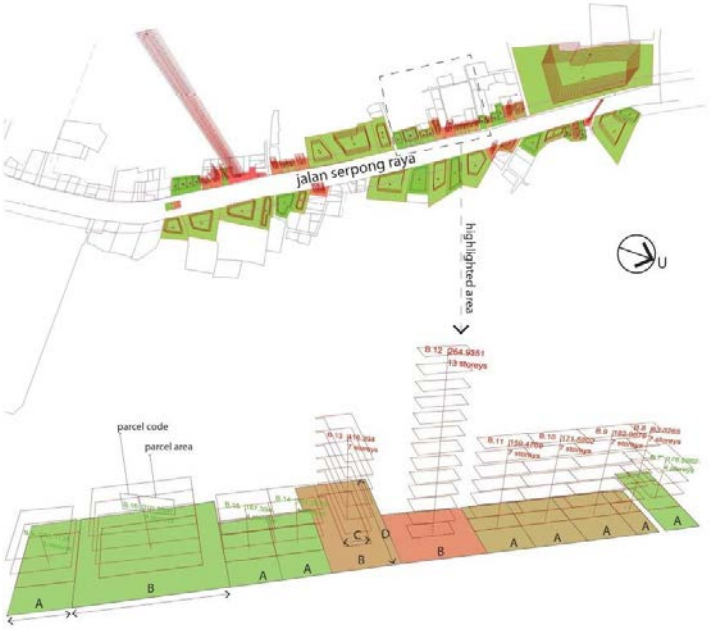

Fig. 3. A Condition of massing as a result of relationship between parcel and regulation

The simulation of this segment (Fig. 3) will result in condition A if the front width of the parcel is less than 15m (assuming the possible width of the building is 6m so that it does not reach the side borders). This condition makes it possible for buildings to have even height. Should the front width of the parcel exceeds 15m (with 4m side borders), condition B is the result. This condition potentially makes it possible for a single building to have a relatively lower or much higher height compared to condition A, depending on the width of the parcel's sides. When the front width of the parcel is lower than 15m with Building Set Back regulation applied to its sides, condition C is the result.

4. Conclusions

The parametric simulation can show us the fast and easier way to work with a lot of parcels. The advantage of this tool also includes easy translation between graphic and worksheet. The two dimensional simulation can show the effectiveness of parcel's built available area in relation to regulation. The three-dimensional simulation of Serpong-Tangerang corridor segment shows some indications of unorderly mass. It does not seem to be possible to regulate building mass simply by the regulations in the Building and Environment Development Plan. Here are some findings of relationship between parcel and regulation as found in parametric simulation:

- Effectiveness of built area will be changed according to the building setback code. The most effective will be achieved of regular parcel with perpendicular position to the street.
- Fluctuation in building height is mainly caused by the total area of the parcel. The probable reason for this condition is the application of a much different KLB for parcels bigger than 3000m^2.
- Such fluctuation is also related to the function and usage, which gives more demanding KLB for commercial blocks.
- This fluctuation also causes uneven building proportion gradient, which is affected by the widths of the parcel. Narrow widths make it impossible to allow some distance between buildings.

The application of these regulations appears to be more effective to control parcels with structured geometric shapes. Shapes that are not structured (that form up polygons less or more than four angles) require a different approach in applying the Building Set Back (BSB), KDB and KLB regulations.

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